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APPLICATION FOR UNITED STATES PATENT

**METHOD AND APPARATUS FOR PROTECTING A
FRICTION BRAKE DISC**

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METHOD AND APPARATUS FOR PROTECTING A FRICTION BRAKE DISC

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BACKGROUND

The present invention is in the field of friction braking systems. More specifically this invention relates to multiple disc brake systems wherein the discs have slots on their periphery which are used to engage splines.

10 In brake assemblies which employ a number of brake discs which are alternately splined to the wheel and the axle, the discs are stressed by contact with the splines. This stress can lead to deterioration of the discs periphery. This is especially apparent when the discs are of a carbon composition (as contrasted with the use of steel to form the discs). Prior art has tried to protect
15 the lug portion of the discs (the peripheral portion between the spline engaging slots) from this stress by covering the slots such that the splines contact the covering, instead of contacting the disc directly. For example US Patent Number 4,511,021 by Grider discloses inserts for this slot. The disclosed insert is flush with the slot, and therefore transfers force directly to the slot walls.

20 Besides the stress on the discs due to the engagement with the splines, the discs can also deteriorate due to thermal oxidation and catalytic oxidation. Prior art methods have tried to protect the lug portions of the discs by covering the lugs in various ways. For example, US Patent No. 3,972,395 by Jannasch et al covers the lugs with a woven carbon cloth, which is cured on. An insert is then
25 added to cover the slot portion. US Patent No. 4,083,434 by Pinter comprises larger segments of protective cover, which cover the lug portion and the slot portion in one piece. Both of these designs also contact the slot wall portions, and thus transfer loads directly to the slot walls.

Prior art methods have also covered the log portion with a U-shaped cap,
30 riveted to the lug, which had a slight overhang to keep the spline from wearing

the slot wall. However, the spline would wear away, or deform this overhang in use, leaving no protection for the slot wall.

Tests have shown that the disc carbon material is much stronger when loaded via rivets or other fastening device, instead of being loaded via the slot walls. Therefore a lug protection method and apparatus is desired which would protect the lug from thermal and catalytic oxidation while at the same time protecting the lug from stress loads by not loading the slot wall.

SUMMARY OF THE INVENTION

A protective lug cap assembly for protection of a lug of a friction brake disc comprises a lug cap, and a load bearing fastening device. The disc has a periphery, with a plurality of circumferentially spaced slots, separating a plurality of circumferentially spaced lugs. The slots are separated by a distance, and disposed for engagement by a spline of a torque device. Each of the slots have two generally radially extending wall portions, wherein each wall portion has a top, a bottom, and opposing sides, and a bottom surface extending between and interconnecting the wall portion bottoms. The lug cap has a lug cap face, wherein the lug cap covers one of the slot wall portions and extends circumferentially away from the slot on the slot wall top and the slot wall opposing sides, covering a portion of the lug. The lug cap face is a portion of the lug cap which covers the slot wall portion. The load bearing fastening device is operative to fasten the lug cap to the lug, such that said lug cap face does not contact the slot wall portion.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a cross sectional view of a disc brake and wheel assembly according to an aspect of the invention.

FIGURE 2 is an isometric view of a brake disc with protective lug cliip according to an aspect of the invention.

FIGURE 3 is a front view of a brake disc with protective lug cap assembly according to an aspect of the invention.

FIGURE 4 is a front view of a brake disc according to an aspect of the invention.

FIGURE 5 is a front view of part of a brake disc with protective lug cap assembly according to an aspect of the invention.

FIGURE 6 is an isometric view of part of a brake disc according to an aspect of the invention.

FIGURE 7 is an isometric view of a protective lug cap according to an aspect of the invention.

FIGURE 8 is a front view of a stator disc according to an aspect of the invention.

DETAILED DESCRIPTION

Various aspects of the invention are presented in Figures 1-8 which are not drawn to scale and in which like components are numbered alike. Referring now to these Figures, according to an aspect of the invention, a protective lug cap assembly **20** for protection of a lug **30** of a friction brake disc **10** is shown. This invention is useful for protection of both a rotor (see Figures 2-6) and a stator (see Figure 8). The rotors rotate about an axis of rotation **70** (see Figure 1). The disc **10** has a periphery with a plurality of circumferentially spaced slots **40** separating a plurality of circumferentially spaced lugs **30**. The slots **40** are disposed for engagement by a spline **80** of a torque device. In the case of a rotor, the periphery with the spline engaging slots is the outer periphery **12**. In the case of a stator, the periphery with the spline engaging slots is the inner periphery **13**. Each slot **40** has two generally radially extending wall portions **42**, wherein the wall portions **42** have a top **41** a bottom **43**, and opposing sides **45**, and a bottom surface **44** extending between and interconnecting the wall portion bottoms **43**. The slots **40** are separated by a distance **46**. The protective lug cap assembly **20** comprises a lug cap **35** and a load bearing fastening device **37**.

The lug cap **35** covers one of the slot wall portions **42** and extends circumferentially away from the slot **40** on the slot wall top **41** and the slot wall opposing sides **45**, covering a portion of the lug **30**. The lug cap **35** has a face,

33, wherein the lug cap face **33** is the portion of the lug cap **35** which covers the slot wall portion **42**, and is roughly parallel to the slot wall portion **42**.

The load bearing fastening device **37** is operative to fasten the lug cap **35** to the lug **30**, such that the lug cap face **33** does not contact the slot wall portion **42**.

5 According to an aspect of the invention, there is a gap **50** between the lug cap face **33** and the slot wall portion **42**. In a preferred embodiment, the gap **50** is approximately 0.04 inches (approx. 0.10 cm). This gap **50** will vary depending on the application, the stresses that will be seen by the lug cap face **33**, and the material type used for the lug cap **35**. This gap **50** should be large enough such
10 that under most operating conditions, when loaded, the lug cap face **33** does not load the slot wall **42**.

The load bearing fasteners **37** may be any suitable fastener known in the art. According to an aspect of the invention, the load bearing fasteners **37** are rivets. The fastening device **37** is fastened approximately parallel to the axis of rotation
15 **70** of a rotor disc. According to a further aspect of the invention, the load bearing fasteners **37** are spaced to share the load between them. One such configuration is shown (Figures 2-6), wherein the first load bearing fastener **37** is approximately 0.42 inches (approx. 1.07 cm) from the slot wall **42**, and the next load bearing fastener **37** is approximately 0.6 inches (approx. 1.52 cm) from the
20 first load bearing fastener **37**. In each case however, the load bearing fasteners **37** should be spaced such that the shear stresses on the brake disc **10** are acceptable.

According to a further aspect of the invention the lug cap **35** extends circumferentially away from the slot **40** approximately one half of the distance **46**
25 to an adjacent slot **40**.

According to an aspect of the invention, the lug cap **35** is made of a corrosion and heat resistant material such as a steel alloy, which may be treated or coated to improve these properties. In a preferred embodiment of the invention, the lug cap **35** is comprised of a cobalt alloy. In a further preferred embodiment, the
30 cobalt alloy is specifically Stellite® 21 (a registered trademark of the Deloro Stellite Holdings Corp).

Testing has shown that disc carbon material is much stronger when loaded via a load bearing fastening device **37** such as rivets, compared to when it is loaded via the slot wall portion **42**. Therefore the load margin imposed on the lug can be increased by loading via a load bearing fastening device **37**.

5 Thus according to an aspect of the invention, a method of load transfer from a torque device spline **80** to a lug **30** of a friction brake disc **10** to increase the disc's load margin, comprises covering the slot wall portion **42** with a lug cap **35**, and mounting the lug cap **35** to the lug **30** with a load bearing fastening device **37**, such that a force applied to the lug cap **35** will be transferred to the lug via
10 the fastening device **37**, and not via the slot wall portion **42**. The lug cap **35** covers one of the slot wall portions **42** and extends circumferentially away from the slot **40** on the slot wall top **41** and the slot wall opposing sides **45**, covering a portion of the lug **30**. The lug cap **35** has a face, **33**, wherein the lug cap face **33** is the portion of the lug cap **35** which covers the slot wall portion **42**, and is
15 roughly parallel to the slot wall portion **42**.

According to an aspect of the invention, this loading is accomplished by mounting the lug cap **35** such that the lug cap face **33** does not contact the slot wall portion **42**.

In a further preferred embodiment, there is a gap **50** between the lug cap
20 face **33** and the slot wall portion **42**, and the gap **50** is approximately 0.04 inches.

While the invention has been explained in relation to its preferred embodiments, it is to be understood that various modifications thereof will become apparent to those skilled in the art upon reading the specification.
25 Therefore, it is to be understood that the invention disclosed herein is intended to cover such modifications as fall within the scope of the appended claims.